1   1.   An identification system comprising:

2   a plurality of identifiable elements;

3   a plurality of labels, each label associated with a unique or non-unique

4   identifiable element, the labels including reference markers and other markers, the labels

5   generating spectra in response to excitation energy; and

6   an analyzer for identifying the elements from the spectra of the associated

7   labels, the analyzer calibrating the spectra using reference signals generated by the

8   reference markers.

1   2.   The identification system of claim 1, wherein the labels comprise

2   semiconductor nanocrystals.

1   3.   The identification system of claim 2, wherein each reference

2   marker comprises at least one reference semiconductor nanocrystal.

1   4.   The identification system of claim 3, wherein the reference markers

2   comprise a plurality of reference semiconductor nanocrystals, the reference markers of

3   each label generating a reference signal at a reference wavelength with a reference

4   intensity.

1   5.   The identification system of claim 4, wherein the other markers

2   comprise other semiconductor nanocrystals generating other signals at other wavelengths

3   and with other intensities.

1   6.   The identification system of claim 1, wherein the other markers

2   comprise code signal markers which generate code signals different than the reference

3   signals, the spectra comprising the marker signals and the code signals, and wherein, for

4   at least one label, the analyzer discretely quantifies the code signals emitted by the code

5   signal markers of the label by comparison of the code signals with the reference signal

6   and by selecting signal characteristics of the code signals from among a plurality of

7   discrete, predetermined signal characteristics.

1   7.   The identification system of claim 6, wherein the reference signal

2   of each label has a reference intensity, and wherein the code signals of the label have

3   code signal intensities, the analyzer discretely quantifying the code signal intensities by

4   comparison to the reference intensity of the label.

1   8.   The identification system of claim 7, wherein the code signal

2   intensities define discrete ratios with the associated reference intensities.

1   9.   The identification system of claim 7, wherein, for each label, the

2   reference intensity comprises at least one member selected from a group consisting of: a

3   highest intensity of the spectra, a lowest intensity of the spectra, a shortest wavelength

4   peak of the spectra, and a longest wavelength peak.

1   10.   The identification system of claim 1, wherein at least some of the

2   reference signals of the labels have common reference wavelengths.

1   11.   The identification system of claim 1, where the reference signals of

2   at least some of the labels have different reference wavelengths.

1   12.   The identification system of claim 11, wherein each reference

2   signal has a reference wavelength, the reference wavelength being a shortest or a longest

3   wavelength of the spectra of the label.

1   13.   The identification system of claim 1, wherein the reference signals

2   have reference wavelengths, and wherein the other signals have other wavelengths, the

3   other wavelengths of each label being discretely quantifiable by reference to the reference

4   wavelength of the label.

1   14.   The identification system of claim 1, wherein the spectrum of a

2   first label comprises signals having a plurality of wavelengths, wherein a spectrum of a

3   second label comprises signals having the plurality of wavelengths, and wherein the

4   analyzer calibrates spectra intensities of the first and second labels based on the reference

5   signals to distinguish the first and second labels.

1   15.   The identification system of claim 1, further comprising at least

2   1000 labels with associated identifiable elements.

1   16.   The identification system of claim 1, further comprising fewer than

2   1000 label with associated identifiable elements.

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1   17.   The identification system of claim 1, wherein the analyzer
2 comprises a tangible media embodying a machine readable code, the code comprising a
3 listing of a plurality of distinguishable labels.

1   18.   The identification system of claim 17, wherein the code further
2 comprises a listing of identifiable elements and a correlation between each
3 distinguishable label and an associated identifiable element having the distinguishable
4 label.

1   19.   The identification system of claim 1, wherein the identifiable
2 elements comprise at least one member selected from the group consisting of a
3 composition of matter, a fluid, an article of manufacture, a consumer product, and a
4 component for an assembly.

1   20.   A method for sensing a plurality of identifiable elements, the
2 method comprising:
3   labeling each identifiable element with a reference marker and at least one
4 associated other marker;
5   energizing the markers of a first label from a first identifiable element so
6 that the markers generate signals;
7   measuring a spectrum of the signals; and
8   identifying a first identifiable element from the spectrum by calibrating the
9 spectrum with reference to a reference signal from the reference marker of the first label.

1   21.   A library of elements, the library comprising:
2   a plurality of identifiable elements, each identifiable element having an
3 associated label with a reference marker, the labels generating spectra in response to an
4 excitation energy, each spectrum including a spectral calibration reference signal from the
5 reference marker.

1   22.   The library of claim 21, wherein the labels comprise semiconductor
2 nanocrystals.

1   23.   The library of claim 22, wherein the semiconductor nanocrystals
2 generate the signals in response to the excitation energy, each reference marker
3 comprising at least one reference semiconductor nanocrystal.

1   24.   The library of claim 23, wherein at least some of the labels
2 comprise at least one other semiconductor nanocrystal generating another signal at
3 another wavelength in response to the excitation energy, the other wavelength different
4 than a reference wavelength of the reference signal.

1   25.   The library of claim 22, wherein at least some of the labels
2 comprise other markers associated with the reference marker, the other markers
3 generating other signals in response to the excitation energy, the other signals differing
4 from the associated reference signals, and discretely quantifiable by comparison of the
5 other signals with the associated reference signals.

1   26.   The library of claim 25, wherein the reference signals have
2 reference intensities, and wherein the other signals have other intensities, the other
3 intensities each being discretely quantifiable by comparison to the associated reference
4 intensity.

1   27.   The library of claim 26, wherein ratios defined by the other
2 intensities to the associated reference intensities define discrete intensity ratio increments.

1   28.   The library of claim 25, wherein, for each spectrum, the reference
2 intensity is a highest intensity of the spectrum or a lowest intensity of the spectrum.

1   29.   The library of claim 25, wherein at least some of the labels have a
2 first other intensity higher than the reference intensity, and a second other intensity lower
3 than the reference intensity.

1   30.   The library of claim 25, wherein, for each label, the reference
2 signal has a reference wavelength, the reference wavelength being a shortest or a longest
3 wavelength of the spectra of the label.

1   31.   The library of claim 25, wherein the reference signals have
2 reference wavelengths and the other signals have other wavelengths, at least some of the

3   labels including a first other wavelength shorter than the reference wavelength of the

4   label, and a second other wavelength longer than the reference wavelength of the label.

1   32.   The library of claim 25, where the reference signals of at least

2   some of the labels have differing reference wavelengths.

1   33.   The library of claim 25, wherein at least some of the reference

2   signals of the labels have common reference wavelengths.

1   34.   The library of claim 25, wherein the reference signals of the labels

2   have differing reference wavelengths.

1   35.   The library of claim 21 wherein the spectrum of a first label

2   comprises signals having a plurality of wavelengths, wherein a spectrum of a second label

3   comprises signals having the plurality of wavelengths, the first and second spectra having

4   differing overall intensities, the first and second labels distinguishable by calibration of

5   the first and second spectra based on intensities of the reference signals of the first and

6   second signals, respectively.

1   36.   The library of claim 21, further comprising at least 1000

2   differentiable labels.

1   37.   The library of claim 21, further comprising fewer than 1000

2   differentiable labels.

1   38.   The library of claim 21, further comprising a tangible media

2   embodying a machine readable code, the code comprising a listing of the labels.

1   39.   The library of claim 38, wherein the code further comprises a

2   listing of identifiable elements and a correlation between each label and an associated

3   identifiable element having the label.

1   40.   The library of claim 21, wherein the identifiable elements comprise

2   at least one member selected from the group consisting of a composition of matter, a

3   fluid, an article of manufacture, a consumer product, a bead, and a component for an

4   assembly.

1   41.   A method comprising:

2   labeling an identifiable element with a label;

3   measuring a spectrum generated by the label, the spectrum comprising a

4 plurality of signals; and

5   identifying the element by selecting a first wavelength range

6 encompassing a first signal of the spectra, and by determining a wavelength of the first

7 signal within the first range.

1   42.   The method of claim 41, wherein the element is labeled by

2 applying at least one semiconductor nanocrystals to the element, the semiconductor

3 nanocrystals generating at least some of the signals in response to excitation energy.

1   43.   The method of claim 41, further comprising selecting a second

2 wavelength range encompassing a second signal of the spectra, and by determining a

3 wavelength of the second signal within the second range.

1   44.   The method of claim 43, further comprising, for each other signal

2 of the spectra, selecting another wavelength range encompassing the other signal and

3 determining a wavelength of the other signal, wherein no more than one signal of the

4 spectra is disposed within each wavelength range.

1   45.   The method of claim 43, wherein the wavelengths of the first and

2 second signals are determined by selecting the wavelengths of the signals from a plurality

3 of discrete wavelengths within the ranges.

1   46.   The method of claim 45, wherein the discrete wavelengths within

2 each range are sufficiently close that two signals at adjacent discrete wavelengths within

3 the range would substantially overlap.

1   47.   The method of claim 45, wherein the discrete wavelengths within

2 the ranges are predetermined.

1   48.   The method of claim 45, wherein the discrete wavelengths within

2 the ranges are separated by about 5 nm or more.

1   49.   The method of claim 45, wherein the discrete wavelengths within

2 the ranges are separated by about 30 nm or more.

1   50. The method of claim 45, wherein the ranges are separated.

1   51. The method of claim 50, wherein the ranges are sufficiently
2 separated so that a pair of signals at adjacent discrete wavelengths within adjacent
3 wavelength ranges are sufficiently separated for independent identification of the discrete
4 wavelengths of each signal of the pair.

1   52. The method of claim 50, wherein the ranges are separated by more
2 than about 30 nm.

1   53. The method of claim 50, wherein each wavelength range includes
2 at least 5 predetermined discrete wavelengths.

1   54. The method of claim 53, wherein there are at least three non-
2 overlapping wavelength ranges.

1   55. The method of claim 41, further comprising identifying a plurality
2 of elements in response to spectra generated from other labels associated with the
3 elements by selecting wavelength ranges encompassing signals of the spectra, and by
4 determining wavelengths of the signals within the ranges.

1   56. The method of claim 55, wherein no more than one signal from
2 each spectrum is disposed within each wavelength range.

1   57. The method of claim 55, further comprising establishing
2 predetermined wavelength ranges, the plurality of elements being identified using the
3 predetermined wavelength ranges.

1   58. The method of claim 57, further comprising establishing
2 predetermined discrete wavelengths within the predetermined wavelength ranges, the
3 wavelengths of the signals being selected from the predetermined wavelengths.

1   59. The method of claim 55, further comprising rejecting labels having
2 excessive overlap between adjacent discrete wavelengths from different adjacent
3 wavelength ranges.

1   60.   The method of claim 55, wherein the wavelength determining step

2   comprises a binary determination between a presence of the discrete wavelength and an

3   absence of the discrete wavelength.

1   61.   The method of claim 60, wherein the spectra of the labels comprise

2   a plurality of separated luminescent signals including signals within the first range, the

3   first range being predetermined, and a second predetermined wavelength range, a discrete

4   wavelength of at least one of the signals of each spectrum being different than a discrete

5   wavelength of the spectrum of every other spectrum.

1   62.   The method of claim 55, further comprising measuring a discrete

2   intensity of the discrete wavelength.

1   63.   The method of claim 55, wherein the label and the other labels

2   comprise intermingled markers.

1   64.   The method of claim 63, wherein the signals of a first label are

2   encompassed within the first predetermined wavelength range, and wherein the signals of

3   a second label are encompassed within another wavelength range such that the spectra of

4   the first and second labels are separated.

1   65.   A method for sensing a plurality of intermingled labels, the method

2   comprising:

3   energizing the labels so that the labels generate signals;

4   identifying a first label by measuring a first discrete wavelength from

5   among a plurality of discrete wavelengths within a first wavelength range; and

6   identifying a second label by measuring a second discrete wavelength from

7   among a plurality of discrete wavelengths within a second wavelength range, the first and

8   second ranges being separated.

1   66.   The method of claim 65, further comprising adding a plurality of

2   labels to a fluid at an associated plurality of process steps so that the labels indicate the

3   process steps performed to the fluid.

1   67.   An inventory system comprising:

2   a plurality of identifiable elements; and

3   a plurality of labels having markers, each label associated with an element,

4   each marker generating a signal when energized so that each label emits an identifiable

5   spectrum, at least some of the spectra comprising a plurality of the signals, each signal of

6   the spectra having a discrete wavelength selected from within a dedicated wavelength

7   range, the ranges sufficiently separated so that the signals in different ranges are

8   independently identifiable.

1   68.   The inventory system of claim 67, further comprising an analyzer

2   having a signal sensor in optical communication with the signals and a processor, the

3   processor selecting a first discrete wavelength from among a plurality of discrete

4   wavelengths within a first wavelength range in response to a first signal of a first spectra,

5   the processor selecting a second discrete wavelength from among a plurality of adjacent

6   discrete wavelengths within a second wavelength range, the first and second ranges being

7   separated, the processor having a database of the identifiable elements and the associated

8   labels and generating an element identification signal in response to the first and second

9   selected wavelengths.

1   69.   The inventory system of claim 68, wherein the labels comprises at

2   least one bead including a matrix, the markers including at least one semiconductor

3   nanocrystal supported in the matrix.

1   70.   The inventory system of claim 67, wherein each label comprises at

2   least one bead, and wherein at least some of the beads have a plurality of markers

3   comprising an associated plurality of semiconductor nanocrystal populations, each

4   population including a plurality of semiconductor nanocrystals that emit a substantially

5   uniform wavelength when energized so as to define the signal of the marker.

1   71.   The inventory system of claim 67, wherein each label has a unique

2   spectra including no more than one discrete wavelength selected from a plurality of

3   predetermined wavelengths within each of a plurality of separated wavelength ranges.

1   72.   An inventory label generating method comprising:

2   generating a plurality of candidate labels; and

3   selecting a plurality of acceptably distinguishable labels from among the

4   candidate labels by determining spectra emitted by the candidate labels when the

5   candidate labels are energized, and by comparing the spectra of the candidate labels.

1   73.   The method of claim 72, wherein the labels comprise
2 semiconductor nanocrystals.

1   74.   The method of claim 72, wherein the candidate labels are generated
2 by combining a plurality of markers, each marker emitting a marker signal at an
3 associated signal wavelength in response to excitation energy.

1   75.   The method of claim 72, further comprising directing an excitation
2 energy toward the markers and measuring the spectra emitted by the labels.

1   76.   The method of claim 72, wherein the spectra of the candidate labels
2 are determined by modeling a combination of a plurality of marker signals.

1   77.   The method of claim 76, further comprising calculating at least one
2 of the signals by modeling emissions from a manufacturable marker.

1   78.   The method of claim 77, further comprising adjusting the
2 calculated signals from the manufacturable marker in response to measured marker signal
3 variations.

1   79.   The method of claim 76, further comprising measuring at least one
2 of the signals by energizing a marker so that the marker emits the signal.

1   80.   The method of claim 72, further comprising comparing at least
2 some of the candidate labels with a library of distinguishable labels to determine if the
3 candidate labels are acceptable, and adding acceptable candidate labels to the library.

1   81.   A method for identifying a plurality of identifiable elements, the
2 method comprising:

3   energizing a plurality of labels so that a first marker of each label
4 generates a first signal with a first wavelength peak, at least some of the labels comprising
5 multiple-signal labels, each multiple-signal label having a second marker generating a
6 second signal with a second wavelength peak;
7   measuring the first wavelength peaks;
8   for each multiple-signal label, measuring the second wavelength peak at at
9 least a predetermined minimum wavelength separation from the associated first peak; and

10   identifying the labels in response to the measured peaks.

1   82.   The method of claim 80, wherein each predetermined minimum
2   wavelength separation is at least as large as a full width half maximum (FWHM) of at
3   least one of the associated first peak and the associated second peak.